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EXAMINER	
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1753	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/762,582	HONGO ET AL.	
	Examiner	Art Unit	
	Brian L. Mutschler	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 April 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *6 and 7* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Drawings

1. The drawings are objected to because the reference sign **13** in Figure 13 is not identified in the specification. It appears that reference sign **13** should be changed to **W**, which has been used to identify the wafer substrate. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

2. The disclosure is objected to because of the following informalities:

   a. The disclosure contains numerous references to the claims. Such references should not be used because the claim numbers can change throughout the prosecution of the application, and can therefore lead to inaccuracies in the specification. References to the claim numbers can be found on page 6 at line 28; page 8 at line 5; page 9 at lines 10, 11 and 28; page 10 at lines 1, 12 and 13; page 11 at lines 1, 2, 17 and 18; page 12 at lines 25 and 26; page 13 at lines 5 and 6; page 16 at line 20; and page 17 at lines 25, 26 and 27.

   b. On page 13 at lines 16 and 23, "R1" should be changed to --R_1--.

   c. On page 25 at line 28, "c" should be changed to --C--.

   d. On page 30 at line 11, "87" should be changed to --97--;

e. On page 32 at line 3, the second occurrence of "83" should be changed to --84--.

f. On page 34 at line 26, "LQ" should be changed to --L_Q--.

g. The reference sign **11** shown in Figure 1 is not identified in the specification.

Appropriate correction is required.

Claim Objections

3. Claims 9 and 21 are objected to because of the following informalities:

a. In claim 9 at line 14, "R1" should be changed to --R_1--.

b. In claim 9 at line 21, "R2 and R3" should be changed to --R_2 and R_3--.

c. In claim 21 at line 13, "R1" should be changed to --R_1--.

d. In claim 9 at line 19, "R2 and R3" should be changed to --R_2 and R_3--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 3-9 and 11-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 3 recites the preamble "A method or apparatus...according to claim 1". The preamble is indefinite because claim 1 claims a method, and the reference to an apparatus renders the claim indefinite because it is not clear whether the claimed invention in claim 3 is a method or an apparatus. Similar preambles appear in claims 4-8 and 20. It is suggested that the preambles be changed to recite --A method...-- (or An apparatus in the case of claim 20, which depends from an apparatus claim) to maintain consistency with the claim from which they depend. The same applies to dependent claims 9, 11 and 21.

Claim 3 recites the limitation "said electroless plating bath" in line 3. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be deleted amended to provide proper antecedent basis. The same applies to dependent claims 4-7.

Claim 4 recites the limitation "the minimum amount of electroless plating liquid" in lines 2-3. There is insufficient antecedent basis for this limitation in the claim. The phrase is also unclear because the amount comprising "the minimum amount" is not defined. It is suggested that the phrase be changed to --a minimum amount or electroless plating liquid--.

Claim 6 recites the limitation "said minimum amount of prepared electroless plating liquid" in lines 4-5. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --said minimum amount of electroless plating liquid-- or --a minimum amount of prepared electroless plating liquid--. The same applies to dependent claim 7.

Claim 8 recites the limitations "said plating liquid" in line 2 and "said electroless plating bath" in line 3. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrase "said plating liquid" be changed to --a plating liquid--, and the phrase "said electroless plating bath" either be deleted or provided with proper antecedent basis. The same applies to dependent claim 9.

Claim 9 recites the limitation "said electrolytic plating liquid" in lines 2-3. There is insufficient antecedent basis for this limitation in the claim. Furthermore, the plating liquid recited in claim 8 is referring to the electroless plating liquid, not the electrolytic plating liquid. Which plating liquid are the limitations in the instant claims referring to? It is suggested that the phrase be changed to --the plating liquid-- or the limitation be rewritten to clearly identify which plating liquid is being described.

Claim 9 contains the phrase "(M indicating a hydrogen atom, an alkali metal atom, or an amino group)" beginning in line 12. The use of parenthesis renders the claim indefinite because it is not clear if the information contained within the parenthesis is a limitation of the claim. The parenthesis should be removed and the phrase rewritten to positively recite the limitations of the claim. Similar uses of parenthesis occur in claim 21 beginning in line 10. Each occurrence of the parenthetical use should be rewritten.

Formula [A] of claim 9, which recites a compound represented by the formula, X-L-$(S)_n$-L-X, is indefinite because the variable, *n*, has not been defined. The same limitation is recited in formula [A] in claim 21. It was assumed that the value of *n* is any integer.

Claim 11 recites the limitation "said plating liquid" in line 2. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --a plating liquid--. Furthermore, since two plating processes are being carried out in the method of claim 1, the plating process for which the plating liquid identified in claim 11 should also be identified.

Claim 12 recites the limitations "said electroless plating process" in line 2 and "said electroless plating bath" in lines 2-3. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrases be changed to --said electroless plating tank--, which is introduced in claim 2. The same applies to dependent claims 13-19.

Claim 13 recites the limitation "the minimum amount of electroless plating liquid" in line 2. There is insufficient antecedent basis for this limitation in the claim. The phrase is also unclear because the amount comprising "the minimum amount" is not defined. It is suggested that the phrase be changed to --a minimum amount or electroless plating liquid--. The same applies to dependent claims 15 and 17.

Claim 13 recites the limitation "the electroless plating process" in lines 4-5. There is insufficient antecedent basis for this limitation in the claim. Since this limitation is a method step, which does not further limit the structure of the apparatus, it is suggested that the limitation be deleted.

Claims 16, 17 and 18 recite the limitation "said minimum amount of prepared electroless plating liquid" in lines 3-4 of each claim. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --said

minimum amount of electroless plating liquid-- or --a minimum amount of prepared electroless plating liquid--. The same applies to dependent claim 19.

Claim 20 recites the limitation "said plating liquid" in line 2. Claim 20 also recites the limitations "said electroless plating process" and "said electroless plating bath" in lines 2-3. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrases be changed to --a plating liquid used in said electroless plating tank--. The same applies to dependent claim 21.

Claim 21 recites the limitation "said electrolytic plating liquid" in line 2. There is insufficient antecedent basis for this limitation in the claim. Furthermore, claim 20 recites a plating liquid for use in the electroless plating tank and not the electrolytic plating tank, so it is unclear which plating liquid is being defined by the claim. It is suggested that the phrase be modified to provide proper antecedent basis and to clearly identify which plating liquid is being defined.

Claim 22 recites the limitation "said plating liquid" in line 2. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --a plating liquid--. Furthermore, since claim 2 recites two plating process, the plating process for which the limitation applies should also be identified.

Claim 23 recites the limitation "said plating liquid" in line 2. This limitation is indefinite because two plating liquids were identified in claim 10, an electroless plating liquid and an electrolytic plating liquid. Which plating liquid does not include an alkali metal as a pH regulator? The phrase should be amended to clearly identify the plating liquid.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Uzoh et al. (U.S. Pat. No. 6,140,234).

Uzoh et al. disclose a method for plating a semiconductor substrate comprising the steps of depositing a seed layer **6** by an electroless plating method (col. 3, lines 66-67) followed by forming a conductive metal layer **8** by electroplating copper on the seed layer **6** (col. 4, lines 25-26).

Since Uzoh et al. teach all of the limitations recited in the instant claim, the reference is deemed to be anticipatory.

8. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Adams et al. (U.S. Pat. No. 6,143,155).

Adams et al. disclose a method for plating semiconductors wherein the method comprises the steps of forming a barrier layer **70** and a seed layer **80** by processes

including electroless plating (col. 5, lines 60-62), followed by the plating of a metal fill **90** by a process including electroplating (col. 6, lines 1-5).

Since Adams et al. teach all of the limitations recited in the instant claim, the reference is deemed to be anticipatory.

9. Claims 1, 2 and 12 are rejected under 35 U.S.C. 102(e) as being anticipated by Woodruff et al. (U.S. Pat. No. 6,309,524).

Regarding claim 1, Woodruff et al. disclose a method and apparatus for plating semiconductor substrates, wherein the method comprises electrolessly plating a seed layer and electroplating a copper layer onto the seed layer (col. 26, lines 1-28; fig. 50).

Regarding claims 2 and 12, Woodruff et al. describe an apparatus having a plurality of processing reactors comprising three electroless plating reactors and three electroplating reactors (col. 25, lines 52-27; fig. 47-49). The apparatus further comprises a robotic transfer means **1470** capable of transferring and orienting the wafers (col. 25, lines 37-51). Various seals, such as O-ring **295b** are used to hermetically seal the wafer to the chamber so that plating solution cannot reach the contact areas (fig. 15; col. 11, lines 4-10). The plating reactors comprise inlet conduits **50** for supplying the plating solution to the reactor chamber (col. 6, lines 45-47; fig. 1).

Since Woodruff et al. teaches all of the limitations recited in the instant claims, the reference is deemed to be anticipatory.

10. Claim 10 is rejected under 35 U.S.C. 102(b) as being anticipated by JP 63-26400, herein referred to as JP '400.

JP '400 discloses a plating apparatus comprising a single processing tank **1** having a plurality of liquid supply paths (see English abstract; fig. 1). The apparatus is used to plate different layers on a substrate in a single tank by using switchable liquid supply paths controlled by a plurality of valves **20-29** (fig. 1).

Since JP '400 teaches all of the structural limitations recited in the instant claim, the reference is deemed to be anticipatory. Although the intended use recited in the claims is different than the intended use of the device taught by JP '400, the prior art device has all of the structural limitations recited in the instant claim and is deemed to be capable of performing the recited function.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi (U.S. Pat. No. 5,437,777).

Uzoh et al. disclose a method having the limitations recited in claim 1 of the instant invention, as explained above in section 7.

The method of Uzoh et al. differs from the instant invention because Uzoh et al. does not disclose the following:

a. Means for disposing the substrate such that a surface to be processed faces upwardly, as recited in claim 3.

b. Forming a hermetically sealed space by the surface to be processed, as recited in claim 3.

c. Plating liquid supply means, as recited in claim 3.

d. A minimum amount of plating liquid is supplied to the sealed space to plate the substrate, as recited in claim 4.

Kishi discloses an apparatus used for plating wiring patterns on semiconductor devices, wherein the apparatus can be used or either electroless plating or electroplating. The apparatus comprises robotic transfer means **19** for inverting and feeding the wafers **1** and the reaction vessel **50** is hermetically covered, which means the vessel **50** is also sealed by the wafer **1** contacting O-ring **8** as shown in Figure 1 (col. 4, lines 1-23). A pump **11** is used to supply the plating liquid (col. 4, lines 24-34).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Uzoh et al. to use a robotic transfer means as taught by Kishi because the robotic transfer means would automate the system.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Uzoh et al. to use seal the reaction

vessel with the wafer as taught by Kishi because sealing the vessel with the wafer prevents the leakage of plating liquid from the vessel.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Uzoh et al. to use a plating liquid supply means as taught by Kishi because using a pump would provide a consistent supply of plating liquid to the plating vessel.

Regarding the use of a minimum amount of plating liquid recited in claim 4, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Uzoh et al. to use a minimum amount of plating liquid because using a minimum amount of plating liquid would reduce the amount of waste and also reduce the operating cost.

13. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi (U.S. Pat. No. 5,437,777), as applied above to claims 3 and 4, and further in view of Reynolds (U.S. Pat. No. 5,932,077).

Uzoh et al. and Kishi describe a method having the limitations recited in claims 3 and 4 of the instant invention, as explained above in section 12.

The method described by Uzoh et al. and Kishi differs from the instant invention because they do not disclose a pressure pulsation means for generating pressure in the sealed space that is higher than atmospheric pressure and for pulsating the pressure.

Reynolds discloses a plating apparatus used for electroless plating or electroplating comprising a megasonic transducer for generating megasonic energy within the plating chamber (col. 4, lines 25-46). The megasonic transducer is used to "distribute the solution evenly on the substrate, and also break up any bubbles or concentrations that may lead to defects in the plated surface" (col. 3, lines 55-58). Sonic transducers generate pressure waves characterized by periodic compression and rarefaction of the medium through which the sound waves are propagated. The compression causes an increase in pressure over the atmospheric pressure, and the rarefaction causes a decrease in pressure below the atmospheric pressure.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Uzoh et al. and Kishi to use a pressure pulsation generator such as the sonic transducer taught by Reynolds because the sonic transducer can be used to "distribute the solution evenly on the substrate, and also break up any bubbles or concentrations that may lead to defects in the plated surface" (US '077 col. 3, lines 55-58).

14. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi (U.S. Pat. No. 5,437,777), as applied above to claims 3 and 4, and further in view of JP 3-146698, herein referred to as JP '698.

Uzoh et al. and Kishi describe a method having the limitations recited in claims 3 and 4 of the instant invention, as explained above in section 12.

The method described by Uzoh et al. and Kishi differs from the instant invention because they do not disclose a preparation tank for supplying the plating liquid to the sealed space just prior to the electroless plating process.

JP '698 discloses a method for preventing the deterioration of a plating solution by using a chemical dissolving tank to prepare the solution prior to plating (see English abstract). After preparation, the plating solution is fed to a plating device by pump **92** (English abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Uzoh et al. and Kishi to use a preparation tank as taught by JP '698 because the preparation tank prevents the deterioration of a plating solution.

15. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi (U.S. Pat. No. 5,437,777) and JP 3-146698, as applied above to claim 6, and further in view of Courduvelis (U.S. Pat. No. 4,956,097).

Uzoh et al., Kishi and JP '698 describe a method having the limitations recited in claim 6 of the instant invention, as explained above in section 14.

The method described by Uzoh et al., Kishi and JP '698 differs from the instant invention because they do not disclose processing the electroless plating liquid as a waste liquid after performing the electroless plating process.

Performing the plating process depletes the concentration of the materials in the plating bath required for plating. Courduvelis discloses a method for treating used electroless plating liquid as waste to decompose the solution to precipitate out copper (col. 3, line 13 to col. 4, line 5). After decomposition, the solution can safely be discharged into the sewer (col. 3, lines 66-67).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Uzoh et al., Kishi and JP '698 to process the used plating solution as waste as taught by Courduvelis because processing the used plating solution as a waste liquid removes the harmful components from the solution and allows the solution to safely be discharged.

16. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Uzoh (U.S. Pat. No. 6,117,784) and in view of either Dahms et al. (U.S. Pat. No. 5,849,171) or Dahms et al. (U.S. Pat. No. 5,433,840), herein referred to as US '171 and US '840, respectively.

Uzoh et al. disclose a method having the limitations recited in claim 1 of the instant invention, as explained above in section 7. Uzoh et al. further discloses that the plating solution comprises an acidic copper plating bath having sulfuric acid, copper sulfate, chloride ions and brighteners such as polyalkylene glycols (the compounds having the basic formula [B] recited in claim 9 of the instant invention) (col. 4, lines 25-64). Additionally, Uzoh et al. disclose the use of other additives, such as sulfur-

containing compounds such as disulfides and safranine-type dyes, and nitrogen containing compounds (col. 4, lines 48-64).

The method of Uzoh et al. differs from the instant invention because Uzoh et al. does not disclose the following:

a. The electroless plating liquid has a concentration of copper sulfate of 100 to 250 g/L, a concentration of sulfuric acid of 10 to 100 g/L, and a concentration of chloride ions of 0 to 100 mg/L, as recited in claim 8.

b. The plating liquid has a sulfur compound expressed by formula [A] at a concentration of at least 0.14 to 70 μmol/L, a macromolecular compound expressed by formula [B] at a concentration of 10 to 5000 mg/L, and a nitrogen compound at a concentration of 0.01 to 100 mg/L, as recited in claim 9.

In US '784, Uzoh discloses a method similar to the method disclosed by Uzoh et al. in US '234 to form a wiring pattern on a semiconductor substrate. The copper may be electroplated or electrolessly plated using an acidic copper plating bath having the same components as the bath disclosed in US '234: copper sulfate, sulfuric acid, chloride ions, polyalkylene glycols, sulfur-containing compounds and nitrogen-containing compounds (col. 3, line 38 to col. 4, line 9).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used an acidic plating bath having the components disclosed by Uzoh et al. for electrolessly plating copper because in US '784, Uzoh

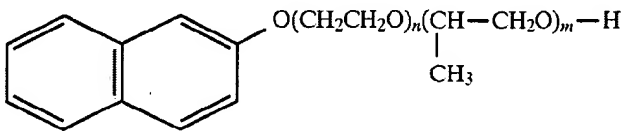
teaches that copper can be electroplated or electrolessly plated using an acidic copper plating bath.

US '171 discloses a plating solution for plating copper, wherein plating bath contains a solution comprising 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 0.02-0.25 g/L of sodium chloride (NaCl), which provides chlorine ions at a concentration of 12-151 mg/L (col. 4, lines 15-28).

US '171 also discloses the use of a sulfur-containing additive, which can include bis-(w-sulfopropyl)-disulfide disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 54-67). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 µmol/L (col. 4, line 55).

The plating solution in Example 1 of US '171 further comprises 0.02 g/L (20 mg/L) of a nitrogen-containing compound, 7-dimethylamino-5-phenyl-phenazonium chloride (col. 4, lines 57-58).

US '171 also discloses the use of polyethylene glycol and polypropylene glycol polymers and copolymers having the basic formula recited in formula [B] of the instant invention. The plating solution contains a β-naphtholalkoxylate shown by the general formula below, where n=0-50 and m=0-50:



In Example 1, US '171 teaches the use of 25 mg/L of the β-naphtholalkoxylate shown above, as well as 200 mg/L of polyethylene glycol (col. 4, line 54 to col. 5, line 4).

When the plating bath taught in US '171 is used, the plating has "a mirror finish and is well smoothed" and has no voids (col. 5, lines 1-4).

US '840 discloses a plating solution and a method for using a plating solution for plating the conductors of printed circuits, wherein the plating solution comprises 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 10 to 180 mg/L of chloride ions (col. 3, lines 68 to col. 4, line 8).

US '840 discloses the use of 7-dimethylamino-5-phenyl phenazonium chloride, which is a nitrogen-containing compound (col. 4, lines 45-46).

US '840 discloses the use of bis-(ω-sulfopropyl)disulfide, disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 41-42). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μmol/L (col. 4, line 41-42).

US '840 teaches the use of polyethylene glycol and polypropylene glycol in concentrations of 0.2 g/L and 0.6 g/L, respectively (col. 4, lines 40-68). Both polyethylene glycol and polypropylene glycol have chemical formulas contained in Formula [B]. The molecular weight of the polyalkylene glycols is between 500 and 35000 g/mol (col. 2, lines 2-4), which corresponds to a value of m+k of about 8 to about 800, wherein m=k because the repeating unit is the same.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Uzoh et al. to use a plating bath having the composition taught by Dahms et al. in either US '171 or US '840 because both solutions have been shown to plate copper having a smooth uniform surface with no voids.

17. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Miyazawa et al. (U.S. Pat. No. 4,303,443).

Uzoh et al. disclose a plating method having the limitations recited in claim 1 of the instant invention, as explained above in section 7.

The method of Uzoh et al. differs from the instant invention because Uzoh et al. do not disclose the plating solution not including an alkali metal as a pH regulator.

The plating liquid used by Uzoh et al. is an acidic copper plating bath (col. 4, lines 38-39). An alkali metal hydroxide is a basic solution typically used to maintain the pH of basic plating liquids and would therefore not be required or desired in an acidic plating bath such as the one used by Uzoh et al.

Additionally, Miyazawa et al. teach the use of a plating solution comprising a source of cupric ions and additives, wherein pH regulators can be used to maintain the pH at a basic pH of 11-13.5 (col. 3, lines 63-68). Such pH regulators can include alkali metal hydroxides, alkaline earth metal hydroxides and ammonium hydroxide (col. 3, lines 63-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made that the plating bath of Uzoh et al., if required to achieve desired results, could use a pH regulator such as alkaline earth metal hydroxides or ammonium hydroxide, which can be used equivalently to alkali metal hydroxides to control the pH, as taught by Miyazawa et al.

18. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524).

Woodruff et al. disclose an apparatus having the limitations recited in claims 2 and 12, as explained above in section 9.

The apparatus of Woodruff et al. differs from the instant invention because Woodruff et al. do not disclose supplying a minimum amount of plating liquid to the surface of the substrate. (It is noted that this limitation is an intended used of the apparatus and as such only limits the apparatus insofar as the device is capable of performing the recited use.)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Woodruff et al. to be sized to accommodate the minimum amount of plating liquid required to plate the substrate because minimizing the amount of plating liquid reduces the waste and operating costs.

19. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of Reynolds (U.S. Pat. No. 5,932,077).

Woodruff et al. disclose an apparatus having the limitations recited in claims 2, 12 and 13, as explained above in sections 9 and 18.

The device of Woodruff et al. differs from the instant invention because Woodruff et al. do not disclose a pressure pulsation means for generating a pressure in the sealed space, as recited in claims 14 and 15.

Reynolds discloses a plating apparatus used for electroless plating or electroplating comprising a megasonic transducer for generating megasonic energy within the plating chamber (col. 4, lines 25-46). The megasonic transducer is used to "distribute the solution evenly on the substrate, and also break up any bubbles or concentrations that may lead to defects in the plated surface" (col. 3, lines 55-58). Sonic transducers generate pressure waves characterized by periodic compression and rarefaction of the medium through which the sound waves are propagated. The compression causes an increase in pressure over the atmospheric pressure, and the rarefaction causes a decrease in pressure below the atmospheric pressure.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Woodruff et al. to use a pressure pulsation generator such as the sonic transducer taught by Reynolds because the sonic transducer can be used to "distribute the solution evenly on the substrate, and also

break up any bubbles or concentrations that may lead to defects in the plated surface" (US '077 col. 3, lines 55-58).

20. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of JP 3-146698.

Woodruff et al. disclose an apparatus having the limitations recited in claims 2, 12 and 13, as explained above in sections 9 and 18.

The device of Woodruff et al. differs from the instant invention because Woodruff et al. do not disclose a preparation bath in the vicinity of the sealed space, as recited in claims 16 and 17.

JP '698 discloses a method for preventing the deterioration of a plating solution by using a chemical dissolving tank to prepare the solution prior to plating (see English abstract). After preparation, the plating solution is fed to a plating device by pump **92** (English abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Woodruff et al. to use a preparation tank in the vicinity of the sealed space as taught by JP '698 because the preparation tank prevents the deterioration of a plating solution.

21. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of Reynolds (U.S. Pat. No. 5,932,077), as applied above to claim 14, and further in view of JP 3-146698.

Woodruff et al. and Reynolds describe an apparatus having the limitations recited in claim 14, as explained above in section 19.

The apparatus described by Woodruff et al. and Reynolds differs from the instant invention because they do not disclose a preparation bath in the vicinity of the sealed space.

JP '698 discloses a method for preventing the deterioration of a plating solution by using a chemical dissolving tank to prepare the solution prior to plating (see English abstract). After preparation, the plating solution is fed to a plating device by pump **92** (English abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus described by Woodruff et al. and Reynolds to use a preparation tank in the vicinity of the sealed space as taught by JP '698 because the preparation tank prevents the deterioration of a plating solution.

22. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of JP 3-146698, as applied above to claim 16, and further in view of Courduvelis (U.S. Pat. No. 4,956,097).

Woodruff et al. and JP '698 describe an apparatus having the limitations recited in claim 16, as explained above in section 20.

The apparatus described by Woodruff et al. and JP '698 differs from the instant invention because they do not disclose that the electroless plating liquid is processed as a waste liquid after performing the plating process. (It is noted that this limitation is an

intended used of the apparatus and as such only limits the apparatus insofar as the device is capable of performing the recited use.)

Performing the plating process depletes the concentration of the materials in the plating bath required for plating. Courduvelis discloses a method and apparatus for treating used electroless plating liquid as waste to decompose the solution to precipitate out copper (col. 3, line 13 to col. 4, line 5). After decomposition, the solution can safely be discharged into the sewer (col. 3, lines 66-67).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus described by Woodruff et al. and JP '698 to use a waste processing apparatus to process the used plating solution as taught by Courduvelis because processing the used plating solution as a waste liquid removes the harmful components from the solution and allows the solution to safely be discharged.

23. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of Uzoh (U.S. Pat. No. 6,117,784) and in view of either Dahms et al. (U.S. Pat. No. 5,849,171) or Dahms et al. (U.S. Pat. No. 5,433,840).

Woodruff et al. disclose an apparatus having the limitations recited in claims 2 and 12, as explained above in section 9. Although Woodruff et al. discloses the use of the device for filling trenches and vias with copper through electroless plating and

electroplating (col. 26, lines 7-28), the composition of the plating liquids are not disclosed.

The apparatus of Woodruff et al. differs from the instant invention because Woodruff et al. do not disclose the following:

a. The electroless plating liquid has a concentration of copper sulfate of 100 to 250 g/L, a concentration of sulfuric acid of 10 to 100 g/L, and a concentration of chloride ions of 0 to 100 mg/L, as recited in claim 8.

b. The plating liquid has a sulfur compound expressed by formula [A] at a concentration of at least 0.14 to 70 μmol/L, a macromolecular compound expressed by formula [B] at a concentration of 10 to 5000 mg/L, and a nitrogen compound at a concentration of 0.01 to 100 mg/L, as recited in claim 9.

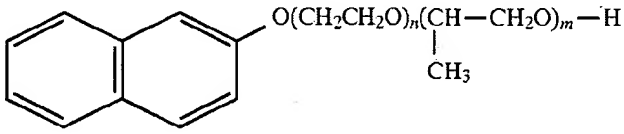
In US '784, Uzoh discloses a method similar to the method disclosed by Woodruff et al. to form a wiring pattern on a semiconductor substrate. The copper may be electroplated or electrolessly plated using an acidic copper plating bath comprising copper sulfate, sulfuric acid, chloride ions, polyalkylene glycols, sulfur-containing compounds and nitrogen-containing compounds (col. 3, line 38 to col. 4, line 9).

US '171 discloses a plating solution for plating copper, wherein plating bath contains a solution comprising 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 0.02-0.25 g/L of sodium chloride (NaCl), which provides chlorine ions at a concentration of 12-151 mg/L (col. 4, lines 15-28).

US '171 also discloses the use of a sulfur-containing additive, which can include bis-(w-sulfopropyl)-disulfide disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 54-67). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 µmol/L (col. 4, line 55).

The plating solution in Example 1 of US '171 further comprises 0.02 g/L (20 mg/L) of a nitrogen-containing compound, 7-dimethylamino-5-phenyl-phenazonium chloride (col. 4, lines 57-58).

US '171 also discloses the use of polyethylene glycol and polypropylene glycol polymers and copolymers having the basic formula recited in formula [B] of the instant invention. The plating solution contains a β-naphtholalkoxylate shown by the general formula below, where n=0-50 and m=0-50:



In Example 1, US '171 teaches the use of 25 mg/L of the β-naphtholalkoxylate shown above, as well as 200 mg/L of polyethylene glycol (col. 4, line 54 to col. 5, line 4).

When the plating bath taught in US '171 is used, the plating has "a mirror finish and is well smoothed" and has no voids (col. 5, lines 1-4).

US '840 discloses a plating solution and a method for using a plating solution for plating the conductors of printed circuits, wherein the plating solution comprises 20-250

g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 10 to 180 mg/L of chloride ions (col. 3, lines 68 to col. 4, line 8).

US '840 discloses the use of 7-dimethylamino-5-phenyl phenazonium chloride, which is a nitrogen-containing compound (col. 4, lines 45-46).

US '840 discloses the use of bis-(ω-sulfopropyl)disulfide, disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 41-42). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μmol/L (col. 4, line 41-42).

US '840 teaches the use of polyethylene glycol and polypropylene glycol in concentrations of 0.2 g/L and 0.6 g/L, respectively (col. 4, lines 40-68). Both polyethylene glycol and polypropylene glycol have chemical formulas contained in Formula [B]. The molecular weight of the polyalkylene glycols is between 500 and 35000 g/mol (col. 2, lines 2-4), which corresponds to a value of m+k of about 8 to about 800, wherein m=k because the repeating unit is the same.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Woodruff et al. to use a plating bath having the composition taught by Dahms et al. in either US '171 or US '840 because both solutions have been shown to plate copper having a smooth uniform surface with no voids. As taught by Uzoh, one skilled in the art would recognize that the plating solutions of Dahms et al. could be used for either electroplating or electroplating.

24. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Woodruff et al. (U.S. Pat. No. 6,309,524) in view of Miyazawa et al. (U.S. Pat. No. 4,303,443).

Woodruff et al. disclose an apparatus having the limitations recited in claims 2 and 12, as explained above in section 9. Although Woodruff et al. discloses the use of the device for filling trenches and vias with copper through electroless plating and electroplating (col. 26, lines 7-28), the composition of the plating liquids are not disclosed.

The apparatus of Woodruff et al. differs from the instant invention because Woodruff et al. do not disclose either the presence or absence of alkali metal as a pH regulator.

Miyazawa et al. teach the use of a copper plating solution comprising a source of cupric ions and additives, wherein pH regulators can be used to maintain the pH at a basic pH of 11-13.5 (col. 3, lines 63-68). Such pH regulators can include alkali metal hydroxides, alkaline earth metal hydroxides and ammonium hydroxide (col. 3, lines 63-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made that the plating bath of Woodruff et al., if required to achieve desired results, could use a pH regulator such as alkaline earth metal hydroxides or ammonium hydroxide, which can be used equivalently to alkali metal hydroxides to control the pH, as taught by Miyazawa et al.

25. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over JP 63-26400 in view of Nobel et al. (U.S. Pat. No. 3,833,486).

JP '400 discloses an apparatus having the limitations recited in claim 10, as explained above in paragraph 10.

The apparatus of JP '400 differs from the instant invention because JP '400 does not disclose the exclusion of alkali metals as pH regulators.

Nobel et al. teach a method for plating metals such as nickel, zinc and iron (metals also used in JP '400), wherein the pH of the plating bath is regulated by a pH regulator such as alkali metal hydroxides or ammonium hydroxide (col. 4, lines 55-66; col. 5, lines 4-8).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the plating bath used by JP '400, if required to achieve the desired results, to have used a pH regulator such as ammonium hydroxide because ammonium hydroxide has been shown by Nobel et al. to be an equivalent compound to alkali metal hydroxides for regulating the pH of the plating solution.

Double Patenting

26. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double

patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

27. Claim 2 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-72 of U.S. Patent No. 6,294,059. Although the conflicting claims are not identical, they are not patentably distinct from each other because the apparatus claimed in US '059 can be used to perform the intended use of the apparatus of the instant claims.

US '059 claims an apparatus comprising a first plating unit and a substrate transfer device (claim 1) and further comprising a second plating unit (claim 9). The second plating unit can be used to plate a second layer over a first layer plated by the first plating unit (claim 13). The plating unit can be either an electroless plating unit or an electroplating unit (claims 4 and 5).

The apparatus of US '059 differs from the instant invention because US '059 does not disclose that the substrate is a semiconductor substrate and the apparatus is used to fill a wiring recess in the substrate.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the apparatus of US '059 to fill wiring recesses in semiconductor substrates because the apparatus of US '059 has all of the structural limitations recited in the instant claim and is capable of performing the recited function.

Conclusion

28. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. GB-122969 discloses a method for electrolessly plating and electroplating in the same tank and also discloses that the same plating solutions can be used for both processes. Hoover et al. (U.S. Pat. No. 4,666,735) disclose a method for forming electric circuits comprising the steps of electroless plating followed by electroplating.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

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blm
May 1, 2003